

## THE MAPPING X-RAY FLUORESCENCE SPECTROMETER (MAPX)

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MapX will provide elemental imaging at  $\leq 100 \mu\text{m}$  spatial resolution over  $2.5 \times 2.5 \text{ cm}$  areas, yielding elemental chemistry at or below the scale length where many relict physical, chemical, and biological features can be imaged and interpreted in ancient rocks. MapX is a full-frame spectroscopic imager positioned on soil or regolith with touch sensors. During an analysis, an X-ray source (tube or radioisotope) bombards the sample surface with X-rays or  $\alpha$ -particles /  $\gamma$ -rays, resulting in sample X-ray Fluorescence (XRF). Fluoresced X-rays pass through an X-ray lens (X-ray  $\mu$ -Pore Optic, “MPO”) that projects a spatially resolved image of the X-rays onto a CCD. The CCD is operated in single photon counting mode so that the positions and energies of individual photons are retained. In a single analysis, several thousand frames are stored and processed. A MapX experiment provides elemental maps having a spatial resolution of  $\leq 100 \mu\text{m}$  and quantitative XRF spectra from Regions of Interest (ROI)  $2 \text{ cm} \leq x \leq 100 \mu\text{m}$ . ROI are compared with known rock and mineral compositions to extrapolate the data to rock types and putative mineralogies.

The MapX geometry is being refined with ray-tracing simulations and with synchrotron experiments at SLAC. Source requirements are being determined through Monte Carlo modeling and experiment using XMIMSIM [1], GEANT4 [2] and PyMca [3] and a dedicated XRF test fixture. A flow-down of requirements for both tube and radioisotope sources is being developed from these experiments. In addition to Mars lander and rover missions, MapX could be used for landed science on other airless bodies (Phobos/Deimos, Comet nucleus, asteroids, the Earth’s moon, and the icy satellites of the outer planets, including Europa.

[1] Schoonjans, T. et al.(2012). *Spectrachim. Acta Part B*, **70**, 10-23. [2] Agostinelli, S. et al. (2003). *Nucl. Instr. and Methods in Phys. Research A*, **506**, 250-303. [3] V.A. Solé et al. (2007). *Spectrochim. Acta Part B*, **62**, 63-68.